A Comparison of Authorship Style in the Document Corpus of the Epistles of St Ignatius of Antioch

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Abstract

This paper is the result of some research in computational stylistics; in particular, the analysis of a document corpus that has attracted the attention of scholars from several disciplines for hundreds of years. This corpus, the *Epistles of Saint Ignatius of Antioch*, was originally written in Greek but this analysis is of a single translation in English. The analysis has been undertaken using a conventional approach in computational stylistics but has employed a number of contemporary software packages, such as a grammar checker, normally used for text and document creation.

Research in this field predominantly characterises authorship style by the use of document statistics, such as word frequency, sentence and paragraph length and in some cases the recurrence of certain phrases. During the research described here it was considered appropriate to use a grammar checker to identify the existence of a 'new' set of characteristics. These include comparing the use of *passive voice*

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across the corpus being analysed, the percentage use of prepositions, as well as document statistics such as sentence and paragraph length, and the application of text readability formulas as indicators of writing style.

The corpus analysed in this paper consists of the seven *Epistles of Ignatius of Antioch*, together with the *Epistle of Polycarp to the Philippians*. The latter epistle has traditionally been held to authenticate the Ignatian writings. It has been suggested by some church historians that Ignatius was not the author of these epistles and may not in fact, have existed as a person at all. Further, they suggest that two paragraphs in the Polycarp Epistle may have been added later by a second author to authenticate the Igantian corpus. In order to contribute to the on-going debate, this paper first examines the Ignatian corpus in order to determine single authorship of the seven epistles. Second, it seeks to determine whether or not the two disputed paragraphs in Polycarp's Epistle to the Philippians vary in authorship style from the rest of that epistle. Third, it compares authorship style in the two inserted paragraphs of Polycarp's Epistle with that of the Ignatian corpus in order to make some observations on the hypothesis that a single author was responsible for both.

1 Introduction

This paper comes out of research into the problem of comparing authorship style across a document corpus, assuming the existence of a single author. It arises specifically for the corpus being analysed here, which is due to long-standing debate over the authenticity of all documents being attributed to the one author.

Research of this nature is plagued by inadequacies in methodologies, due mostly to the arbitrary nature of criteria used for comparing authorship style and the qualitative dynamics that are inherent in stylistic speculation. Many of these issues were raised in 1966 by Sedelow[2] and again by Oakman[3] who says, *"When a scholar chooses to study that quality of literary works called 'style', he is opening Pandora's box. Since Plato and Aristotle, critics have attempted to define and characterise this elusive phenomenon. Most tend to agree that thought and expression come together in style and have argued over separating content and form for stylistic analysis. While the critic must always be concerned with this organic connection between form and content, he needs methods to describe and sort out style in order to avoid impressionism and vague descriptions of what he senses about an author's style. The advent of the computer, with its ability to count, classify and categorise materials with accuracy and speed, soon led to its adoption for stylistic investigations and the debut of the subdiscipline of computer-assisted literary analysis dubbed 'computational stylistics'."* He goes on to say, *"Strategies for using the computer often include counting some lexical or syntactic characteristics and then applying statistical methods in order to test and validate the significance of the results. Even so, there is little agreement or uniformity about the methods employed. The scholar must be wary that the literary aspects of style not be lost amid a pile of statistical tables and formulas."*

All this caution and indeed scepticism notwithstanding, it was decided to adopt the conventional 'document statistics' approach for the study described in this paper. In part, the research aimed to explore the authorship issue detailed below, but it also wished to test the viability of using contemporary package software for data collection and statistical analysis.

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2. Sally and Walter Sedelow, A preface to computational stylistics, In *The Computer and Literary Style*, ed. J Leed, Kent State Univ Press, 1966, pp:1-13.

3. Robert L. Oakman, Computer methods for literary research, pp:139-140

The primary tool used was grammar checking software. In addition, text was captured in machine-readable form by way of optical character recognition for direct entry to word processing software, which interfaces with the grammar checking software. Results from the grammar checking process were input directly to spreadsheet software for initial descriptive statistical analysis and later to a statistical package for inferential analysis. In all, there was a 'seamless interface' between the software tools used. All work was carried out using a microcomputer hardware environment. Early computational linguistic research, (even up to a few years ago) required that data entry of sometimes enormous texts was by hand through a keyboard, mass storage was limited and computer time was expensive, and virtually all the analytical software had to be purpose-written. Although this study is by no means the first to use combinations of contemporary software of this kind, it is worth noting the milestone in computing for this particular application area.

2 The subject corpus for the research

The background of this research relates to the long-standing tradition of early church history that assumes the existence of Ignatius, a first century bishop who ministered to the Christians of Antioch. Further, that this person was arrested during the persecutions of the Roman Emperor Trajan and taken under guard to Rome where he was martyred in 107AD for his faith. During that journey he is supposed to have written to each of the churches present in the places he stopped. Much of his writing relates to ecclesiastical authority; in particular the obedience of clergy to their bishop. In effect, his epistles have formed the basis, together with other references in scriptural and non-scriptural writings, for the tradition of apostolic succession in the Christian Church. For those Christian churches holding to the three-fold order of *bishop, priest* and *deacon* , the Epistles of Ignatius of Antioch are a primary authority. These writings certainly are amongst the earliest proof of early church structure and organization[4].

Numerous researchers have debated the authenticity of the Ignatian Epistles. In the fifteenth century scholars reduced the 'authentic' set of letters to seven but the arguments over longer and shorter versions, variations in translation from the Greek and points of

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4. See for example, E.Schillebeeckx, *The Church with a Human Face* (p.81), and T.O'Meara, *Theology of Ministry* (p.176). Scriptural passages such as Acts 6:1-6, Phil 1:1, Titus 1:5-9, 1Tim 3:8-13 and Eph 2:20; 4:7-16 are also among those most often quoted in this debate.

theological polemic contained in the writings, kept the debate alive. In 1845 at the British Museum, three letters written in the Syriac dialect and claiming to be three of the Ignatian Epistles (to the Ephesians, Romans and Polycarp) were considered the only authentic ones. In 1885, the 19th century scholar J.B.Lightfoot re-established the seven original (out of fifteen) letters as being authentic. He demonstrated that they were written in first century Greek; the latter eight being in second century Greek. He also raised some questions about the hitherto authenticating contemporary writing, the Epistle of Polycarp to the Philippians. In his celebrated treatise on the Apostolic Fathers he wrote, *"No Christian writings of the second century, and very few writings of antiquity, whether Christian or pagan, are so well authenticated as the Epistles of Ignatius, if the Epistle of Polycarp be accepted as genuine"*.[5] This statement certainly implies some question as to the genuine nature of Polycarp's epistle. Indeed, Polycarp's epistle is thought to contain two *'inserted paragraphs'*[6], which refer to the Ignatian corpus. Nowhere else in the otherwise lengthy letter does Ignatius get a mention. This has raised questions as to when the Ignatian letters were in fact written, by whom and for what purpose. These questions and indeed the more fundamental one pertaining to the existence of Ignatius and whether his being has been used primarily to promote order within the institutional church, have been asked by Robert Joly[7] who disputes the traditional view. He proposes that the entire set of seven letters of Ignatius were written by a forger in Smyrna soon after the death of Polycarp in about 155AD. He believes that the forger read of a martyr named Ignatius, and in an attempt to establish monarchical episcopacy, fabricated the story of Ignatius and wrote the celebrated epistles. It may even be that this forger first learned of the martyred Ignatius from Polycarp's Epistle to the Philippians; whether they had subsequently been inserted or not. Interesting as it may be, such speculation on the existence of Ignatius is not a matter for this paper. Indeed, neither that issue or the debate surrounding the motivations or

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5. J.B. Lightfoot, *The Apostolic Fathers* ,(p.422)

6. The two paragraphs, 9 and 13, reinforce the existence of Ignatius and refer to his letters which are claimed to be in Polycarp's possession. Indeed, Polycarp is sending the Ignatian letters and others to Philippi for the edification of the Church there. Polycarp concludes paragraph 13 by asking that the recipients reply to him with any certain knowledge they have of Ignatius and his 'group' which seems odd given that 60 years is supposed to have passed since the martyrdom of Ignatius. Both these paragraphs have the 'flavour' of a well ordered (if wide spread) Church with a tradition in place of authority from Christ through the Apostles (the "blessed Paul" is frequently mentioned) to Ignatius, Rufus, Zosimus, Polycarp and others.

7. Robert Joly, *Le Dosser D'Ignace D'Antioche* . Amongst other examples which mitigate against the authenticity of the Ignatian Epistles, Joly maintains that Christians were not sent to the lions until 166CE, some fifty or more years after tradition places their writing. He also questions whether an old man going to his death would write such detail as is evident in the Epistles. Such is the spectrum of 'fact' and 'speculation' in this and other works which debate the Ignatius issue.

impact of any of these writings is embarked upon any further here. Rather, this paper is concerned with the use of some computational linguistic techniques as a means of contributing to the scholarly investigation of this and other questions of authorship authentication. It should be noted here that this research uses only translations in English[8], so any results must be considered preliminary in the absence of a comparison with the original Greek text.

The hypothesis being explored is founded on the proposition that if the two paragraphs believed to have been inserted into the Polycarp letter conform to the authorship style in the Ignatian letters, it may be that those letters were written at least 60 years after tradition maintains; perhaps with the intention of validating the ecclesiastical authority paradigm (monarchical episcopacy) being promoted by a faction of the early church which desired leadership within an institutional structure rather than another of a more prophetic and charismatic nature that preferred dynamic participation. Much has been written on the struggle between the charismatic and institutional models of organization within the early church and that it was a real point of departure for early Christians is not in doubt.[9]

3 Authorship attributes

The first set of results comes from an analysis of each of the Ignatian letters and Polycarp's letter to the Philippians under the following categories:

1. Average length of sentences(in words).
2. Average length of paragraphs(in sentences).
3. Use of passive voice(expressed as a percentage).
4. Prepositions as % of total words.
5. Frequency of 'function word' use in each text.

Percentages for word frequencies have been reported due to the variable length of the individual texts; they have been rounded to two decimal places to enable meaningful comparisons to be made. All this data was derived from the corpus using the grammar checking software.

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8. The single translation of M.Staniforth, *Early Christian Writings: the Apostolic Fathers* has been used in this study.

9. See for example, Kevin Giles, *Patterns of Ministry among the first Christians* ,(p.93)

The following abbreviations have been used to identify the writings in the Ignatian corpus:

Eph   = Epistle to the Ephesians
Mag   = Epistle to the Magnesians
Tra   = Epistle to the Trallians
Rom   = Epistle to the Romans
Phi   = Epistle to the Philadelphians
Smy   = Epistle to the Smyrnaeans
Pol   = Epistle to Polycarp

The remaining abbreviations are used to identify sub-sets of the Polycarp letter:

2Para = The two *inserted paragraphs* in Polycarp's
        Epistle to the Philippians
Prest = The remainder of the Polycarp Epistle to
        the Philippians

Table 1 provides a summary of attributes which can be used to compare authorship style. Values for the use of _passive voice_ in the writing and the number of prepositions used are expressed as percentages. The averages for word counts in sentences and sentence counts in paragraphs are expressed as integers.

	Avg words in sentences	Avg sentences in paragraphs	% use of the passive voice	% use of prepositions
Eph	27	4	26	15
Mag	29	3	12	15
Tra	28	3	6	16
Rom	26	5	15	14
Phi	29	4	11	15
Smy	26	4	9	15
Pol	21	4	12	15
2para	33	4	50	15
Prest	30	5	17	14

TABLE 1: Attributes of authorship style

The result for the percentage use of passive voice is also represented in Graph 1 because it appears to reflect the greatest difference between writing styles in the two *inserted paragraphs* when compared with the remainder of the Polycarp letter. The use of passive voice in the two paragraphs also appears to have no correspondence with the Ignatian corpus.
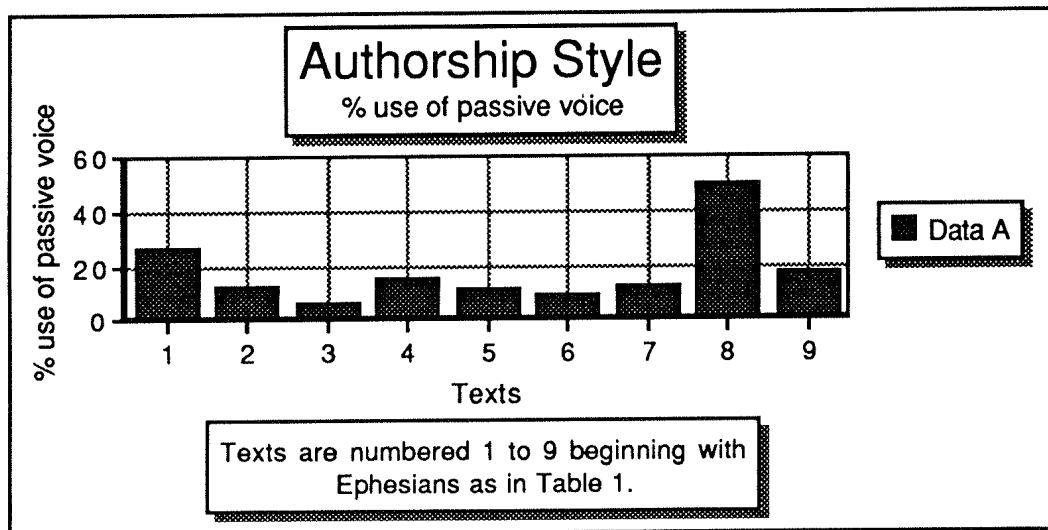
Graph 1: The use of Passive Voice as an attribute of style

Assuming these measures are accurate indicators of authorship style, it is also interesting to note from this graph the variations between each of the Ignatian letters, particularly the Epistle to the Ephesians. Even so, the variations do not seem significant indicators of multiple authorship. In contrast, the two paragraphs from the Polycarp Epistle do seem to reflect a significant variation from the remainder of the letter.

Table 2 illustrates comparative readability scores for each text using the Flesch Reading Ease Score, the Flesch-Kincaid Grade Level and the Gunning Fog Index.[10] These tests are available from within the functionality of the grammar checking software. Again, they are used here merely as 'indicators' of authorship style. There is a sense in which it does not matter how valid they are as measures of readability because they are being used in this study only as an instrument for purposes of comparison. These results provide evidence essentially of conformity by all the texts to similar readability scores. Nothing here

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10. These measures are calculated using word and sentence lengths compared with index values obtained from normalised observations of reading ages and abilities.

distinguishes the Ignatian corpus from either the entire Polycarp epistle or the two paragraphs. Again, there is a variation in the scores between the two Polycarp paragraphs and the rest of the Epistle, but it is not significant and the Flesch Score is less than between say, Ephesians and Magnesians, or Romans and Philadelphians, or Magnesians and the Epistle to Polycarp. This latter Epistle also displays distinct differences when compared with either the two paragraphs or the entire Epistle of Polycarp to the Philippians, which is a point worthy of note in respect of the hypothesis that both may have been written by a single author.

	Flesch score	Flesch-Kincaid score	Gunning's Fog Index
Eph	64	11	14
Mag	58	13	16
Tra	65	12	14
Rom	71	10	13
Phi	60	12	15
Smy	63	11	14
Pol	69	9	12
2 para	59	14	17
Prest	63	12	16

Table 2: Readability Scores

To summarise so far the analysis using these measures, the most distinctive evidence for dissimilarity comes from the use of passive voice in the two disputed paragraphs of the Polycarp Epistle. This evidence alone, is not sufficient to support the hypothesis that they were inserted later by a second author, so word usage is now examined in terms of frequency within each of the texts.

4 Word frequency analysis

It was decided to use a set of words previously published for authorship related research by Jackson.[11] He calls these 'function words'. Ten of the words, *a, and, for, in, it,*

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11. For a discussion of method and results in this topic area and for citations to other research of a similar nature see MacD. P. Jackson and M.W.A. Smith in the bibliography. The approach of using words that are used only

of, that, the, to and *with* are those most frequently occurring in the plays of twenty well-known dramatists, including the Shakespeare canon. All of these words also occur as high frequency words in the Ignatian corpus.

The words **your, as, his** and **be,** also occur in the top ten words of individual Ignatian epistles (notably **his** in *Smy,* **your** in *Eph, Tra* and *Pol* and **as** in *Mag*) with **his** and **be** ranking ninth and tenth in the top ten highest frequency words of the Letter of Polycarp. It was decided to omit them from the first comparative analysis of function words (Tables 3 and 4) because they do not occur in the top ten set across the entire corpus; whereas, interestingly the Jackson set does. The additional words were included in the second comparative analysis; Tables 5 and 6.

Six further words are those sensitive to context such as the personal pronouns *I, you, my, me,* the verb *is* and the negative *not.* The others three words counted are from among the most common conjunctions and prepositions; *but, by* and *from* . These are also taken from the Jackson function word set.

Table 4 contains the results of applying the chi-square formula to the data in Table 3. The sum of the scores for each Ignatian Epistle is converted to a percentage to allow a meaningful proportional comparison to be made. The same is true for the two sets of values that relate to the Polycarp Epistle. The pool mean is calculated for the Ignatian corpus and is used as the expected value(E_i) in the chi-square formula. Each function word value for the individual epistles is used as the observed values ($O_{i..n}$). The same is true for the Polycarp Epistle dissection.

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once in the text, as discussed in A.Q.Morton cited in the bibliography, is not employed here but could be the subject of a future study. The same is true of the non-linear mapping technique used by H.H. Greenwood in his study of the Pauline Epistles.

Fxn Words	Eph	Mag	Tra	Rom	Phi	Smy	Pol	Mean	2Pr	Prest	Mean
a	49	18	21	27	19	19	24	25.28	5	18	11.5
and	109	58	53	46	67	70	46	64.14	15	97	56.00
but	11	9	8	8	11	8	3	8.28	3	4	3.50
by	25	7	3	13	15	22	10	13.57	3	10	6.50
for	39	16	34	41	24	36	26	30.85	4	39	21.50
from	21	13	10	9	11	10	3	11	3	12	7.50
in	74	55	41	33	46	48	27	46.28	5	49	27.00
it	23	15	12	18	17	13	14	16	0	16	8.00
of	114	80	70	75	68	63	34	72	11	90	50.50
that	39	35	25	23	27	23	10	26	6	33	19.50
the	149	100	71	80	89	112	70	95.85	10	117	63.50
to	90	69	42	76	55	75	61	66.85	11	83	47.00
with	29	18	13	12	17	11	11	15.85	0	14	7.00
I	37	23	38	63	31	22	9	31.85	5	12	8.50
you	64	30	29	31	27	34	29	34.85	9	39	24.00
my	10	7	14	30	16	14	10	14.42	0	4	2.00
me	15	5	15	41	12	10	8	15.14	1	4	2.50
is	50	33	24	34	29	29	21	31.42	1	25	13.00
not	8	10	18	16	8	3	6	9.85	3	18	10.50
FWord totals	956	601	541	676	589	622	422	281	95	684	389.5
Text totals	2832	1709	1553	1828	1688	1869	1331		267	2202	

Table 3: Function Words used in the texts

The totals for each occurrence of function words can be seen above. In Table 4 below, each of these totals is expressed as a proportion of the total words in each text. This allows a meaningful comparison of function word frequency to be made.

The chi-square value is then calculated for each total yielding some interesting results as can be seen in Table 4 and the ranked list that follows.

Fxn Words Mean	Eph	Mag	Tra	Rom	Phi	Smy	Pol	Mean	2Pr	Prest
a	1.73	1.05	1.35	1.48	1.13	1.02	1.8	1.366	1.87	0.82	1.345
and	3.85	3.39	3.41	2.52	3.97	3.75	3.46	3.479	5.62	4.41	5.015
but	0.39	0.53	0.52	0.44	0.65	0.43	0.23	0.456	1.12	0.18	0.65
b y	0.88	0.41	0.19	0.71	0.89	1.18	0.75	0.716	1.12	0.45	0.785
for	1.38	0.94	2.19	2.24	1.42	1.93	1.95	1.721	1.5	1.77	1.635
from	0.74	0.76	0.64	0.49	0.65	0.54	0.23	0.579	1.12	0.54	0.83
i n	2.61	3.22	2.64	1.81	2.73	2.57	2.03	2.516	1.87	2.23	2.05
i t	0.81	0.88	0.77	0.98	1.01	0.7	1.05	0.886	0	0.73	0.365
o f	4.03	4.68	4.51	4.1	4.03	3.37	2.55	3.896	4.12	4.09	4.105
that	1.38	2.05	1.61	1.26	1.6	1.23	0.75	1.411	2.25	1.5	1.875
the	5.26	5.85	4.57	4.38	5.27	5.99	5.26	5.226	3.75	5.31	4.53
t o	3.18	4.04	2.7	4.16	3.26	4.01	4.58	3.704	4.12	3.77	3.945
with	1.02	1.05	0.84	0.66	1.01	0.59	0.83	0.857	0	0.64	0.32
I	1.31	1.35	2.45	3.45	1.84	1.18	0.68	1.751	1.87	0.54	1.205
you	2.26	1.76	1.87	1.7	1.6	1.82	2.18	1.884	3.37	1.77	2.57
m y	0.35	0.41	0.9	1.64	0.95	0.75	0.75	0.821	0	0.18	0.09
m e	0.53	0.29	0.97	2.24	0.71	0.54	0.6	0.84	0.37	0.18	0.275
i s	1.77	1.93	1.55	1.86	1.72	1.55	1.58	1.709	0.37	1.14	0.755
not	0.28	0.59	1.16	0.88	0.47	0.16	0.45	0.57	1.12	0.82	0.97
Totals	33.76	35.18	34.84	37	34.91	33.31	31.71	34.39 MEAN	35.56	31.07	33.315 MEAN
χ^2	0.011	0.018	0.006	0.199	0.008	0.034	0.208		0.151	0.151	

Table 4: Percentage use of function words

As can be seen, the proportional differences between individual texts are small and all within 3-4% of one another. The chi-square values confirm the closeness of fit between each of the Ignatian Epistles and indeed between the two paragraphs of the Polycarp Epistle and the remainder of that text. Without further evidence from other data, it would seem that using word frequencies to support the hypothesis that the Polycarp Epistle contains two paragraphs inserted by a second author is not proven.

Table 5 contains the Jackson function word set together with those words that were in the top ten occurring words in the individual texts both of the Ignatian corpus and Polycarp Epistle. Table 6 reflects the result of carrying out a similar analysis to that represented by the results in Table 4. As can be seen, the chi-square values are somewhat different from the first set of results but are statistically insignificant in their discrimination between the texts.

Fxn Words	Eph	Mag	Tra	Rom	Phi	Smy	Pol	Mean	2Pr	Prest	Mean
a	49	18	21	27	19	19	24	25.28	5	18	11.50
and	109	58	53	46	67	70	46	64.14	15	97	56.00
but	11	9	8	8	11	8	3	8.28	3	4	3.50
by	25	7	3	13	15	22	10	13.57	3	10	6.50
for	39	16	34	41	24	36	26	30.85	4	39	21.50
from	21	13	10	9	11	10	3	11	3	12	7.50
in	74	55	41	33	46	48	27	46.28	5	49	27.00
it	23	15	12	18	17	13	14	16	0	16	8.00
of	114	80	70	75	68	63	34	72	11	90	50.50
that	39	35	25	23	27	23	10	26	6	33	19.50
the	149	100	71	80	89	112	70	95.85	10	117	63.50
to	90	69	42	76	55	75	61	66.85	11	83	47.00
with	29	18	13	12	17	11	11	15.85	0	14	7.00
I	37	23	38	63	31	22	9	31.85	5	12	8.50
you	64	30	29	31	27	34	29	34.85	9	39	24.00
my	10	7	14	30	16	14	10	14.42	0	4	2.00
me	15	5	15	41	12	10	8	15.14	1	4	2.50
is	50	33	24	34	29	29	21	31.42	1	25	13.00
not	8	10	18	16	8	3	6	9.85	3	18	10.50
your	43	0	27	0	0	0	28	14	0	0	0
as	0	23	0	0	0	0	0	23	0	0	0
his	0	0	0	0	0	24	0	24	0	29	29
be	0	0	0	0	0	0	0	0	0	39	39
FWord totals	999	624	568	676	589	646	450	650.29	95	752	423.5
Text totals	2832	1709	1553	1828	1688	1869	1331	1830	267	2202	1312.4

Table 5: Function Words used in the texts

Fxn Words	Words Mean	Eph	Mag	Tra	Rom	Phi	Smy	Pol	Mean	2Pr	Prest
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but	0.39	0.53	0.52	0.44	0.65	0.43	0.23	0.456	1.12	0.18	0.65
by	0.88	0.41	0.19	0.71	0.89	1.18	0.75	0.716	1.12	0.45	0.785
for	1.38	0.94	2.19	2.24	1.42	1.93	1.95	1.721	1.5	1.77	1.635
from	0.74	0.76	0.64	0.49	0.65	0.54	0.23	0.579	1.12	0.54	0.83
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of	4.03	4.68	4.51	4.1	4.03	3.37	2.55	3.896	4.12	4.09	4.105
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you	2.26	1.76	1.87	1.7	1.6	1.82	2.18	1.884	3.37	1.77	2.57
my	0.35	0.41	0.9	1.64	0.95	0.75	0.75	0.821	0	0.18	0.09
me	0.53	0.29	0.97	2.24	0.71	0.54	0.6	0.84	0.37	0.18	0.275
is	1.77	1.93	1.55	1.86	1.72	1.55	1.58	1.709	0.37	1.14	0.755
not	0.28	0.59	1.16	0.88	0.47	0.16	0.45	0.57	1.12	0.82	0.97
your	2	0	2	2	0	0	0	0.857	0	0	0
as	0	1	0	0	0	0	0	0.143	0	0	0
his	0	0	0	0	1	0	0	0.143	0	2	1
be	0	0	0	0	0	0	0	0	0	2	1
Totals	35.28	36.51	36.57	36.98	34.89	34.56	33.81	35.51	35.56	34.15	34.86
								MEAN			MEAN
χ^2	0.001	0.028	0.032	0.061	0.011	0.025	0.081		0.014	0.014	

Table 6: Percentage use of function words

The ranking of the chi-square values in Table 7 yields some differences when the additional high frequency words from this corpus have been integrated with Jackson's set but they do not change the essential similarity between either the Ignatian texts or the Polycarp dissection. Indeed, whilst a strong similarity exists within the Polycarp Epistle, none of the Ignatian Epistles have a value that matches those for Polycarp.

Text name	Jackson fxn words	This corpus fxn words
Eph	0.011	0.001
Mag	0.018	0.028
Tra	0.006	0.032
Rom	0.199	0.061
Phi	0.008	0.011
Smy	0.034	0.025
Pol	0.208	0.081
2Pr	0.151	0.014
Prest	0.151	0.014

Table 7: Chi-square values for two tests with function words

The variations in these values are not statistically significant. The probability of any stylistic difference supporting the hypothesis that multiple authors were responsible for the Polycarp Epistle is zero by this result and almost zero within the Ignatian corpus, where p>0.95 given a χ^2 value of 0.64 with 6 degrees of freedom. Indeed, the difference made by adding the extra four high frequency words has been minimal, giving a paired t value of 1.366 (where 0.<p<0.375), also with 6 degrees of freedom, with a mean for Jackson words minus the additional words (x-y) of 0.035.

5 Conclusions

This research evolved from a study of the emergence of ecclesiastical authority in the early Christian Church. Some questions have been raised by other scholars in connection with the authenticity of the corpus thought to have been written by Saint Ignatius of Antioch. In particular, the principal authenticating document, the Epistle of Polycarp to the Philippians, only refers to the Ignatian Epistles in two paragraphs, which have been the subject of dispute in terms of their validity as part of the original text. It has been suggested that these two paragraphs were added later by a second author in order to authenticate the Ignatian corpus. It is these issues that this paper has sought to contribute to by way of a stylometric analysis of the texts concerned.

In the pursuit of this study it was decided to apply the functionality of a contemporary grammar checking software product. In light of the results it yielded for the methodology being employed in this instance, there is no doubt it provided a more than adequate research tool resource. The combination of modern methods for text data entry, data capture and analysis has brought a new dimension to computational linguistics research, which was often hampered by the lack of hardware and software functionality.

The analysis of the texts using a range of authorship attributes, particularly identifying the use of passive voice and the application of readability comparisons, has yielded nothing statistically significant to support the hypothesis that either the Ignatian Epistles were written by multiple authors or that the Polycarp Epistle was written by multiple authors. Word frequency analysis using both a set of function words developed by an independent researcher in addition to a set developed for this corpus has not revealed any statistically significant differences in style either. On the contrary, the results seem to indicate a definite similarity in word usage, particularly in the Polycarp Epistle. The likelihood of the same author being responsible for all or part of the Ignatian Epistles and the two paragraphs of Polycarp seems remote indeed. Quite apart from the lack of statistical evidence, at least as presented here, it is generally held that the Ignatian Epistles have a spirited and fiery quality, whereas Polycarp is dull and without passion.

It is hoped that this analysis has at least contributed to the ongoing debate concerning Saint Ignatius of Antioch and his Epistles. Further work may yet expose differences and similarities to resolve the matter. It has certainly contributed an insight to the use of contemporary computing facilities to the field of computational linguistics.

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